SUBLIMINAL ACOUSTIC MANIPULATION OF NERVOUS SYSTEMS

BACKGROUND OF THE INVENTION

The central nervous system can be manipulated via sensory pathways. Of interest here is a resonance method wherein periodic sensory stimulation evokes a physiological response that peaks at certain stimulus frequencies. This occurs for instance when rocking a baby, which typically provides relaxation at frequencies near ½ Hz. The peaking of the physiological response versus frequency suggests that one is dealing here with a resonance mechanism, wherein the periodic sensory signals evoke an excitation of oscillatory modes in certain neural circuits. The sensory pathway involved in the rocking example is the vestibular nerve. However, a similar relaxing response at much the same frequencies can be obtained by gently stroking a child's hair, or by administering weak heat pulses to the skin, as discussed in U.S. Pat. No. 5,800,481, Sep. 1, 1998. These three types of stimulation involve different sensory modalities, but the similarity in responses and effective frequencies suggests that the resonant neural circuitry is the same. Apparently, the resonance can be excited either via vestibular pathways or via cutaneous sensory pathways that carry tactile or temperature information.

Near 2.5 Hz another sensory resonance has been found that can be excited by weak heat pulses induced in the skin, as discussed in U.S. Pat. No. 5,800,481, Sep. 1, 1998. This sensory resonance brings on a slowing of certain cortical functions, as indicated by a pronounced increase in the time needed to silently count backward from 100 to 70 with the eyes closed. The effect is sharply dependent on frequency, as shown by a response peak a mere 0.13 Hz wide. The thermally excited 2.5 Hz resonance was found to also cause sleepiness, and after long exposure, dizziness and disorientation.

Other, more obscure types of stimulation in the form of weak magnetic fields or weak external electric fields can also cause the excitation of sensory resonances, as

SUMMARY OF THE INVENTION

Experiments have shown that atmospheric acoustic stimulation of deeply subliminal intensity can excite in a human subject the sensory resonances near ½ Hz and 2.5 Hz. The ½ Hz resonance is characterized by ptosis of the eyelids, relaxation, drowsiness, a tonic smile, tenseness, or sexual excitement, depending on the precise acoustic frequency near ½ Hz that is used. The observable effects of the 2.5 Hz resonance include a slowing of certain cortical functions, sleepiness, and, after long exposure, dizziness and disorientation. The finding that these sensory resonances can be excited by atmospheric acoustic signals of deeply subliminal intensity opens the way to an apparatus and method for acoustic manipulation of a subject's nervous system, wherein weak acoustic pulses are induced in the atmosphere at the subject's ears, and the pulse frequency is tuned to the resonance frequency of the selected sensory resonance. The method can be used by the general public for control of insomnia and anxiety, and for facilitation of relaxation and sexual arousal. Clinical use of the method includes the control and perhaps a treatment of anxiety disorders, tremors, and seizures. A suitable embodiment for these applications is a small portable battery-powered subaudio acoustic radiator which can be tuned to the resonance frequency of the selected sensory resonance.

There is an embodiment suitable for law enforcement operations in which a subject's nervous system is manipulated from a considerable distance, as in a standoff situation. Subliminal subaudio acoustic pulses at the subject's location may then be induced by acoustic waves radiating from a venting acoustic monopole, or by a pulsed air jet, especially when aimed at the subject or at another material surface, where the jet velocity fluctuations are wholly or partly converted into static pressure fluctuations.

The described physiological effects occur only if the intensity of the acoustic stimulation falls in a certain range, called the effective intensity window. This window has been measured in exploratory fashion for the 2.5 Hz resonance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a preferred embodiment wherein a modulated air jet is used for inducing subliminal acoustic pulses in the atmosphere at the subject's ears, for the purpose of manipulating the subject's nervous system.

FIG. **2** shows an embodiment in which a pulsed air jet is produced by modulating the flow from a fan by a cylindrical sheet valve that is driven by a voice coil.

FIG. **3** shows schematically an acoustic monopole operated by a solenoid valve.

FIG. **4** shows the circuit of a simple generator for producing voltage pulses that drive a piezoelectric speaker.

FIG. **5** depicts a portable battery-powered device that contains the circuit and the piezoelectric speaker of FIG. **4**.

FIG. **6** shows schematically a generator for chaotic pulses.

FIG. **7** depicts a circuit for generating a complex wave.

FIG. **8** illustrates an application in a law enforcement standoff situation.

FIG. **9** contains experimental data that show excitation of the sensory resonance near 2.5 Hz, and the effective intensity window.

FIG. **10** depicts experimental data showing that the sensory excitation occurs via the ear canal.

FIG. **11** shows the buildup of the physiological response to the acoustic stimulation.

FIG. **12** shows schematically an acoustic monopole operated by a rotating valve.

DETAILED DESCRIPTION OF THE INVENTION

It has been found in our laboratory that deeply subliminal atmospheric acoustic pulses with frequency near ½ Hz can evoke in a human subject a nervous system response that includes ptosis of the eyelids, relaxation, drowsiness, the feeling of pressure at a centered spot on the brow, seeing moving patterns of dark purple and greenish yellow with the eyes closed, a soft warm feeling in the stomach, a tonic smile, a "knot" in the stomach, sudden loose stool, and sexual excitement, depending on the precise acoustic frequency used. These responses show that this sensory resonance involves the autonomic nervous system.

The sharp peaking of the physiological effects with frequency is suggestive of a resonance mechanism, wherein the acoustic stimulation, although subliminal, causes excitation of a resonance in certain neural circuits. Since the frequencies and responses are similar to those for the ½ Hz sensory resonance discussed in the Background Section, it appears that the resonance excited by the described acoustic stimulation is indeed the ½ Hz sensory resonance. It has been found that the 2.5 Hz sensory resonance can be excited acoustically as well. This sensory resonance causes the slowing of certain cortical processes, sleepiness, and eventually dizziness and disorientation.